**Gain evaluation for low-density np/nB >1 proton- Boron fusion plasmas**

S. D. Moustaizis [1]\*, C. Daponta[1]\*, S. Eliezer [2], Z. Henis [2], P. Lalousis [3]\*,

N. Nissim [2] and Y. Schweitzer [2]

*[1] Technical University of Crete, Lab of Matter Structure and Laser Physics, Chania, Crete, Greece*

*[2] Applied Physics, Soreq Nuclear Research Center, Yavne, Israel*

*[3] Institute of Electronic Structure and Laser FORTH, Heraklion, Greece*

**Abstract**

Fusion energy power plans based on compact magnetic fusion devices are funded in the USA and China [1, 2, 3]. For this type of devices, *p-11B* fuel is attractive, not only because of its corresponding aneutronic nuclear fusion reaction, which produces three (3) charged alpha particles of *8.7 MeV* total energy that can directly be converted into electricity, but also because it is not necessary to be equipped with breeding technologies for the production of the necessary components of the fusion fuel (p, 11B plenty abundant in nature). The last few years, power plans based on laser ignited fusion, have proposed the use of the *p-11B* fuel [4]. The disadvantages of the *p-11B* fuel are the Bremsstrahlung radiation losses and the fact that *p-11B* nuclear reaction presents a maximum at approximately 670 keV, which is high compared to the 10 keV ofD-T fuel. Theoretical works [5,6] investigate the interpretation of the relatively high alpha particle generation (1011) of the recent laser-based *p-11B* fusion experimental results [7, PALS facility], through the introduction of the chain reaction and the avalanche effect. The latter effects are responsible for the energy transfer from the fusion born alphas to the *p*, *11B* fusion species and the improvement of the reaction rate (RR). The use of a multi-fluid code enables us to evaluate the temporal evolution of the fusion medium parameters, the necessary time for the reaction rate (RR) maximization, the energy transfer from the produced alpha to the fusion species (*p*, *11B*), which results to an important increase of the energy of the latter to values corresponding to the optimum *p-11B* cross section and the contribution of the produced alphas density on the rapid rise of the RR [8, 9, 10, 11].. The numerical simulations concern initial densities of *10 19 – 10 20 m-*3, which are close to magnetic confinement fusion, and initial temperatures of the order of *80 keV* or lower, that are relatively low, compared to the energy corresponding to the maximum of the *p-11B* fusion cross section. In the present work, the initial density conditions are selected with a ratio of np/nb > 1, favorable for the Bremsstrahlung losses optimization. The numerical results show the importance of the chain reaction and the avalanche effect, that contribute to the feasibility of *p-11B* fusion ignition for relatively low initial medium temperatures. The gain evaluation for two distinct cases with density ratio of the fusion species *np/nΒ > 1* will be explored and compared: i) A *p-11B* fusion medium with initial temperature typically at *80 keV* and ii) The interaction of a Boron plasma of *80 keV* initial temperature with protons (proton fluid with energy lower than 1 MeV). These numerical results could be applied for potential experiments, using magnetic mirror-like configuration. Potential experimental set up with the related diagnostics will be presented and discussed.

**References**

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